International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 04 Issue: 10 | Oct -2017 www.irjet.net p-ISSN: 2395-0072

APPLICATION OF FACTOR ANALYSIS IN THE ASSESSEMENT OF SURFACE WATER QUALITY IN BUCKINGHAM CANAL, MUTTUKADU ESTUARY,TAMILNADU, INDIA

M.R.KUPPUSAMY[1], N.MAHALAKSHMI[2], R.SURESHKUMAR[3], C.VANITHA[4]

[1,2,3,4] *Assistant Professor's, PG and Research Department of Chemistry, R.V.Govt.Arts College, Chengalpattu, India*

Abstract: The present study assesses the factor analysis of the physico-chemical parameters surface water quality of Buckingham canal muttukadu estuary. The results reveled that various parameters like DO, BOD, TA, total hardness, pH, TDS etc. were found to be higher side at estuary and canal waters. The data set consists 6 seasons, two monsoon, pre monsoon, two post monsoons and summer conducted in 6 sampling stations point in the Buckingham canal muttukadu estuary. Thirteen parameters were monitored in the sampling point on a seasonal basis December 2013 – December 2015, the data set was treated principal component analysis (PCA) and factor analysis on principal component. Four factors were identified as responsible for the data structure explained 73.17% of total variance in the data set. The first factor explained 31.30% total variance , The second factor explained 22.02% of variance and the third and fourth factor explained 10.22% and 9.63% of variance respectively.

Key words: Buckingham canal, muttukadu estuary, principal component analysis, factor analysis and water quality.

1. INTRODUCTION

Water is one of the most important natural resources for the development of agriculture, industries and navigations etc, among all the water bodies' estuaries and coastal areas are complex and dynamic aquatic environment. Estuarine eco-system represents one of the most important ecologically productive elements, rivaling tropical source for rich flora and fauna. They are fertile and are excellent nursery ground for a variety of commercially important fishes and crustaceans. They act as a source of food for human beings and recreational site for bathing and other water sports, tourist's places etc. Pitchard (1957) [1] has provided the most accepted definition of an estuary, which is defined as "a semi-enclosed coastal water body of water, which has free connection with the sea and within which sea water is measurably diluted with fresh water derived from land drainage". Due to constant interaction of sea water with the fresh water and associated turbulence, estuaries from a highly variable and dynamic environment. Estuaries act as connecting links in transfer of the anthropogenic inputs in to the sea. Sewage and industrial wastes are dumped in to the estuaries and rivers, from where they are enter in to sea, depending on the flushing rate in the estuary. Due to increasing urbanization and industrialization, the volume of the domestic sewage and industrial waste is constantly on the rise. Sewage combined with industrial waste substantially leads to the degradation of the adjoining sea. In this context the monitoring of the estuarine system is important, as it serve as a primary source receiving the land based pollutants and its subsequent discharge in the open sea. The qualitative and quantitative analysis of Buckingham canal water to determined different pollutants present. [2-5]. The present study deals with water quality characterizations of muttukadu estuary, Buckingham canal and the resulting data treated with factor analysis.

2. Materials and methods

The present study was carried out for south Buckingham canal and Muttukadu estuary is located South of Chennai in Tamilnadu. These water bodies discharge treated/untreated industrial effluents, urban sewage etc. Through muttukadu estuary to the nearby coast. This estuary hence expected to contain elevated levels of pollutants relative to the open sea environment. The sampling was carried out during the period December-2012 , December-2015.During the study period water samples were collected on seasonal basis two monsoon seasons [December 2012 and December 2015] ,two post

monsoon seasons[January 2013 and January-2014] ,one summer[May-2013] and pre monsoon seasons [September 2013]. Muttukadu estuary consisting of four sampling points inside the estuary and two points were located buckingham canal. Due to logistics, one sampling carried out on a particular month of every season. The surface water samples were collected using a precleaned and acid washed one liter PET [Polyethylene] bottles were used for collection of water samples from surface water during morning days 8.00am to 10.00am. The temperature, conductivity and pH were measured insitu at filed itself using portable water quality analyzer [ELICO Model-PE138]. Collected water samples were brought immediately. The analysis of various water quality parameters was done as per the standard methods for examination of water and waste water [21st edition][6] 2005 published by APHA. Among the major cations sodium and pottassium were analyzed by Flame photometer [ELICO-Model-360].

2.1 Factor Analysis

Factor analysis offers a powerful means of detecting similarities among the variables [or] samples. The purpose of factor analysis is interpreting the structure with in the variance - covariance matrix of data collections. All computations were performed by means of on SPSS - 16 version software has been used to carry out the analysis. The data set have been standardized by using standard statistical procedures. The techniques used extraction of eigen values and eigen vectors from the matrix of correlations .The interpretations is based on rotated factors, rotated loadings and rotated eigen values.

3. Results and Discussion

The data so obtained for various water quality parameters were organised in a data matrix. Principal component analysis was carried out to extract the various factors which include the percentage variances explained by each component. The eigenvalues for different factors, percentage variance accounted, cumulative percentage variance and components loadings are given in Table-2.

Table-3 shown above reflects the eigen values and variance percentages corresponding to the principal components after varimax rotation. The varimax rotation was performed to secure increased principal components of chemical/environmental significance. This analysis resulted in the explanation of 73.17% of variances in the data.

The principal component analysis was performed on the correlation matrix between different parameters are shown in Table - 1. The phisco chemical parameters having high degrees of correlations [$0.5 \leq r \leq 0.9$] are [EC, Na, Cl, TDS, TH, Mg, Ca] these strong correlation between the parameters given above clearly indicate that they have domestic waste water discharge from chennai city followed by varimax rotation and the same has been used to examine the association between them. The parameters loading for the four components from the principal component analysis. It can be seen from Table- 3 most of the variables associated with each factor are well defined and contribute very little to the other factors, which helps interpretation of results.

The First factor is charcterised by very high loadings of TDS, EC and moderate high loadings of Cl, TH and K. This factor reveals that the Na, EC and TDS in the study area are mainly due to Na and Cl. The second factor [which accounts for 22.02% of the varience] is mainly associated with very high positive loading of Ca, Mg, BOD and also moderate loading of DO in surface waters. [Signs of sewage runoff]. Factor3 and 4 characterised by the dominance of only one variance each such as. TSS [factor3] pH [factor4] and together these two factors account or 19.85% of the total variance. The single dominance of variables in each factor indicates non-mixing [or] partial mixing of different types of water. The fourth factor with high loading only on pH , possibly due to biogenic or organic controls on the pH value of water.

4. CONCLUSIONS

Factor analysis applied to the Buckingham canal, muttukadu estuary surface water quality dataset provided information on composition of the samples of waste water generated by domestic, agriculture and industrial waste. Further it shows that water quality influenced by sewage waste have relatively high pollution load exhibited by sewage characteristic variable such

as BOD, TDS, TH and Cl. It is believed that these results could be very useful to the local authorities for the pollution control and management.

Table-1: PCA General Approch correlation matrix variables

	DO	BOD	pH	TDS	EC	TSS	TA	Ca	Mg	TH	Na	K	Cl
DO	1.000												
BOD	-0.488	1.000											
pH	0.210	-0.214	1.000										
TDS	0.233	0.071	0.068	1.000									
EC	0.342	-0.171	0.217	0.810	1.000								
TSS	0.221	0.101	0.189	0.070	0.074	1.000							
TA	-0.133	0.040	-0.036	-0.597	-0.570	0.140	1.000						
Ca	0.100	-0.503	-0.014	0.043	0.157	-0.179	0.005	1.000					
Mg	0.540	-0.617	0.198	0.121	0.290	-0.095	-0.133	0.513	1.000				
TH	0.373	-0.319	0.027	0.461	0.576	0.239	-0.447	0.362	0.269	1.000			
Na	0.053	0.204	-0.100	0.714	0.734	-0.115	-0.636	-0.152	-0.150	0.422	1.000		
K	0.128	0.013	-0.084	0.268	0.339	-0.229	-0.408	0.200	0.184	0.444	0.415	1.000	
Cl	0.417	0.288	0.168	0.506	0.625	-0.140	-0.434	0.192	0.379	0.584	0.440	0.312	1.000

Table-2: Eigenvalues and varience percentages corresponding to the Priencipal components

Principal Component	Eigen value	% of Varience	Cumulative Varience %
1	4.488	34.525	34.525
2	2.510	19.307	53.832
3	1.537	11.82	65.652
4	0.977	7.518	73.170
5	0.754	5.801	78.971
6	0.716	5.507	84.478
7	0.527	4.053	88.531
8	0.496	3.833	92.364
9	0.368	2.833	95.197
10	0.242	1.862	97.059
11	0.167	1.282	98.341
12	0.138	1.063	99.404
13	0.078	0.596	100.000

Table-3: Varimax rotated Factor loading matrix

Variables	Factor1	Factor2	Factor3	Factor4
DO	0.244	0.580	0.372	0.275
BOB	0.041	-0.850	0.018	-0.147
pH	0.087	0.198	0.074	0.794
TDS	0.858	-0.023	0.134	0.063
EC	0.872	0.205	0.138	0.134
TSS	-0.072	-0.109	0.948	0.128
TA	-0.788	-0.019	0.145	0.024
Ca	-0.018	0.734	-0.100	-0.367
Mg	0.107	0.844	-0.063	0.136
TH	0.599	0.43	0.427	-0.314
Na	0.887	-0.255	-0.049	-0.116
K	0.513	0.189	-0.166	-0.455
Cl	0.676	0.414	-0.037	0.118
Eigen value	4.069	2.862	1.329	1.252
Percentage of Varience	31.3	22.02	10.22	9.63
Cumulative Varience	31.3	53.32	63.54	73.17

REFERENCES

[1] .D Pitchard ,observation of circulation in coastal plain estuaries G.Luff 1967. (ed).,Washington,D.C,Amer.Asso.Adv. Sci,83,37-44.

[2] B. Krishna kumarai, R. Nandhini, S. Kanmani, Analysis of water quality in Buckingham canal, ijre,Vol. 3, issue 3,2016.

[3] A.Saranya, K.Brindha and P. Kasinatha pandian Hydrochemical studies and evaluation of surface water quality along Buckingham canal of chennai city. Ijep 30(6):467-471, 2010.

[4] S. Ravichandran ,Senior research fellow(CSIR). Water quality studies on Bukingham canal (Madras,India) a discrimeinant analysis. Hydrobilogia 154: 121-126,1987.

[5] M.R.Kuppusamy , V.V.Gridhar ,Central Electrochemical Research Institute,Madras unit(CSIR). Factor analysis of water quality characteristics including trace metal speciation in the coastal environment system of Chennai ennore. Elsevier,2005 .

[6] Standard methods for Examination of water & waste water, 21st edition (2005) published by APHA.